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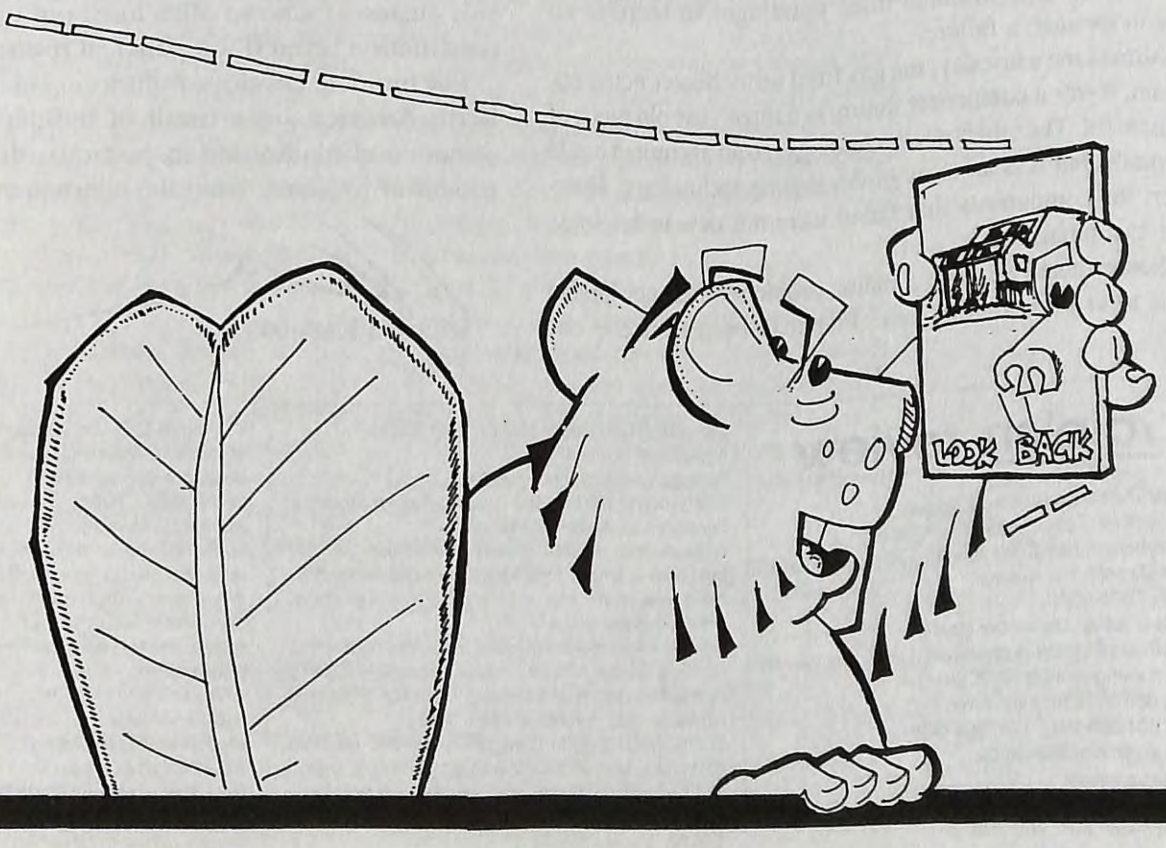
Learning From The Past



From the Editor . . .

As builders and designers we put many different materials together into a unique whole. We rely on the products and services offered by others. Although we have access to a wide range of new products, who hasn't encountered simple products manufactured today that don't perform like older models used to? Far too many manufactured products today are, simply put, shoddy.

It amazes me what manufacturers are getting away with. What's more, we are letting them get away with it. It seems the marketplace doesn't quite work as we would like to believe. You can complain all you want, but to no avail.

This rant was brought on by a couple of incidents I encountered with the mechanical system in my home recently. It started when I discovered that an expansion tank on the heating system was leaking. The mechanical contractor stated, as a matter of fact, that he now stocks such parts to avoid having to make extra trips to the suppliers, as he's noted such premature failures happen regularly now. He's observed that twenty year old systems are often still functioning with the original fittings and components. In my case, the system was only installed three years ago, so there is no reason for such a failure.

Almost the same day, the gas fired water heater acted up. Again, it was a component failure in a three year old piece of equipment. The unit is new technology, so an argument could be made that it is an issue of developing technology. However, the components that failed were not new technology, just cheap parts.

Somewhere, we have a major problem when equipment fails after such a short time. Planned obsolescence is one thing, but this is ridiculous! For the sake of a couple of dollars in manufacturing cost, everything is pared down to the bone. Quality control inspections have probably been reduced too.

Manufacturers may claim that if they built it right, then nobody would buy it, because they would have to charge more for it. There may be an element of truth there, but then again, we don't get too many options - even if we want to buy the better stuff. Good stuff is pulled off the market because, it is claimed, the profit margins aren't high enough.

Somewhere, we've gone off track. If there are few or no options, how can the consumer really choose? The disturbing thing is that the trend is to lessen competition as corporate empires swallow up their rivals. As a result, the opportunity for alternate choices is decreasing at an alarming rate.

It is ironic that one of the last sectors where there is a large degree of free market competition is the construction sector itself. In fact, as we all know, it is so competitive that there are tremendous pressures to cut corners, never mind the poor customer who so often must put up with substandard construction [even if, on paper, it meets code standards].

The building envelope failures in B.C. and other parts of North America are a result of builders or trades cutting corners and inadequate inspections, driven by the manic pursuit of low cost, hang the consequences!

Richard Kadulski,
Editor

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Kitsun Solar Townhouses:

Looking Back at a Demonstration Project

We design and build houses, buildings and communities in a piecemeal fashion. Usually, the design follows what has been done in the past, with perhaps minor modifications. Very rarely do we get much feedback - unless there is an obvious failure or screw up.

Unfortunately, as an industry we don't do much follow up investigation. The lack of follow up is often driven by a fear of being, at best, embarrassed by an error, and at worst, generating a law suit to fix up real or imagined problems.

Occasionally, when a demonstration building is monitored or investigated, we dwell at length on a very narrow aspect. Rarely do we look to see how the occupants relate to the building. Reexamining a project after the initial novelty has passed can give us an insight into how successful the new strategies are over time.

Solar design during the 1970's focused on building performance and operating efficiency at the expense of quality and usability of the occupied space and the comfort of the occupants. Demonstration projects used new technologies to study their performance in an occupied building and to assess their impacts on the design and construction practices.

The Kitsun Solar Townhouses, a demonstration project in Vancouver built in 1978, has been monitored on and off since then. It offers many lessons to be learned if we care to study them.

This is an 8-unit project, with four 3 bedroom units, three 2 bedrooms and one 1 bedroom unit. The building is a 'high-mass' concrete building: with a concrete Trombe wall; filled concrete block partition walls; and concrete floors. When built, it represented state-of-the-art passive solar design in Canada.

The main, and most visible, feature of the complex is the south facing Trombe wall. This solar strategy was chosen because it also provided visual and acoustic privacy, as there is a minimal setback from a major street. The project also included Zomeworks Skylids (automatically operating, insulated louvres, like oversized Venetian blinds), and Insulating curtains over the Trombe walls (these were made of a very reflective, metallized foil material).

Monitoring of this highly publicized project initially concentrated on its energy performance. Purchased energy use for space heat varied widely from 1.5 GJ/year to 30 GJ/year for identical units. The variation was mainly because of differences in occupant lifestyle. However, for many people the remarkably low purchased energy use for most units (averaging 8 - 10 GJ/year) remained incidental to the building's appearance. The contrast between the dark coloured surfaces on the Trombe wall and the highly reflective insulating curtains was the most obvious feature.

Over the past twenty years, energy concerns have become secondary to availability/and afford ability of housing.

Two decades of monitoring the changes made show how the performance of a relatively innovative environmental building can change over time. From the occupant's point of view, the dominant characteristics of the Kitsun project focus on the mechanical failure of the solar systems, comfort and building appearance.

By 1987 monitoring confirmed the experience of earlier passive solar houses. Complex designs (from the standpoint of architectural and mechanical systems) and the expected involvement by occupants in their operation usually fail.

By 1997 a more significant change is evident. Major changes that are in direct conflict with the original design intent have been consciously made by the occupants to the original design.

Skylids

After some adjustment, these generally

worked well, although they were slow to react in heavy overcast weather. They still work today and respond to the day-night cycle as originally designed. However, many occupants are unaware of their operating principle or unable to adjust and maintain them effectively so they are, for the main part, operated manually.

Thermal Mass

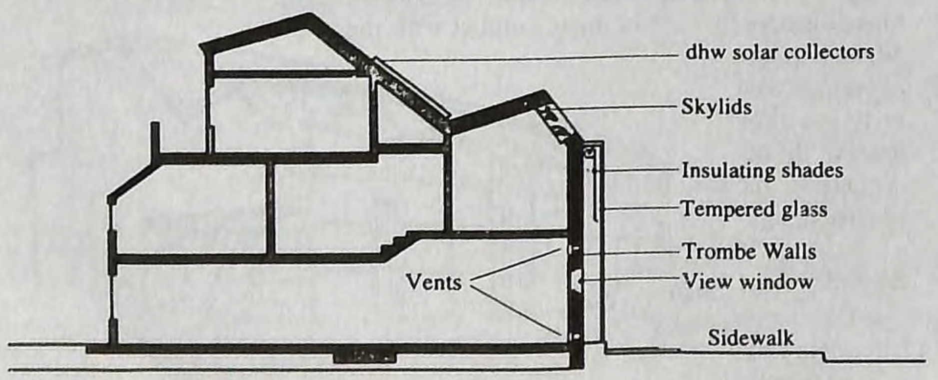
Mass provides balanced, controlled temperature on the ground floor and provides excellent acoustic separation between the units.

A major comfort issue is overheating in the south-facing bedrooms: these small rooms (10 m^2) have a large (2.9 m^2) sloping skylight. Although the Skylids can be closed to exclude unwanted direct solar heat, this also cuts out daylight, making the interior space unpleasant.

In a true Trombe wall, vents at the top and bottom of the wall (with dampers) allow the air to move by natural convection currents. Vents were originally incorporated in the Trombe wall. A small thermostatically controlled fan was also incorporated in the original design to distribute excess heat from the front bedroom to the rooms on the north side. Unfortunately, the fans failed.

Inadequate maintenance also increased the noise generated by the fans, creating an unpleasant environment when in use. Besides, the air is not warm enough to be used as a 'forced-air' system, so it can create drafty conditions. As well, design changes during construction eliminated a direct natural 'path' to draw heat from the air space making them ineffective. Occupants experienced no benefit and soon stopped opening and closing them. Later they put fixed windows into the vent spaces, so there is no possibility for venting. Without effective venting air temperatures stratify and the temperature of upper portion of the wall (which backs onto the bedrooms) increases.

Leaps of Faith: Innovative Environmental Buildings
by Dr. Raymond J Cole and Michelle Steiger, School of Architecture, University of British Columbia
Paper presented at the Solar Energy Society of Canada 1997 annual conference



Section through *Kitsun* 2-Bedroom unit (original insulating shades shades)

Today, the lower vents have been replaced by fixed double glazed windows to prevent down drafts across the living room floor and to add additional acoustic isolation from the busy street

Insulating Curtains on the Trombe Wall

Moveable insulation for night time use was a key thermal control strategy (this was a time before the development of high performance windows). However, experience with moveable nighttime insulation had shown that although it is an important part of passive solar design, it is worthless unless used properly. It must be designed for fail-safe operation.

When run automatically, the blinds eventually jammed. In 1980 they were rebuilt in two units, and operated manually. Because the motors were faulty, they were not rebuilt in the other units, and were removed.

Due to the failure and removal of the full height insulating curtains, deciduous trees were planted in front of the Trombe walls in the late 1980s. This was meant primarily to soften the appearance of the building. Any potential solar shading was seen as a bonus. However, the trees did not survive due to pollution and vandalism, but the trees have recently been replanted (along with a metal picket fence).

Painting of the Trombe walls

The outer surface of the Trombe walls was originally painted a dark colour to increase the absorption of solar energy. Each unit was painted a different colour (dark red, dark blue, etc.), to provide some individuality and variation while still maintaining a high solar absorptivity.

In 1994 the occupants decided to have the Trombe wall repainted in today's fashionable light pastel colours. This reduced the stark appearance of the building and reduced the solar loading on the mass wall during the summer. Some say there has been a reduction in overheating Although direct monitoring has not been done, residents have not noticed any significant changes in their winter heating bills.

What have we learned?

Many problems in this project result from the combination of the use of new designs and technologies, the lack of foresight on how the systems are likely to function over time, and how they can or will be maintained by their occupants. Designers of innovative buildings must anticipate and allow for a

wider range of lifestyles now and over time.

As much thought has to be given to avoiding summer overheating as providing useful winter heating, even in northern locations. It is also important to remember that the actual use and operation of passive solar buildings will be different from the simplified energy and environmental schematics that are often used at the design stages.

Public acceptance of solar housing or any environmentally progressive building is based only in part on energy and environmental benefits. Unless buildings can satisfy a range of use patterns, occupant expectations, provide comfort and ease of operation, with ongoing user education and product replacement, it is unlikely that their intended performance will be sustained over time.

Another way of putting it, is don't forget the KISS principle (i.e., keep it simple, stupid). It does not mean you can't have new and sophisticated systems. Very technologically elegant solutions can be both advanced and simple. However, they must be transparent to the occupant, who in all likelihood is not as excited by the technology as the building professional.

Unless buildings can satisfy a range of uses, occupant expectations, provide comfort and ease of operation, ... it is unlikely that their intended performance will be sustained over time.

The notion of Life-Cycle Assessment has been generally accepted as the only legitimate basis on which to compare alternative materials, components and services. Information gained from this has reinforced the importance of being conscious of the future implications of design decisions.

The advances put into innovative buildings must keep in mind time-honoured desgin expectations and qualities. A highly noticeable aspect of this project is the limited number of openings in the south wall of the suites. This is contrary to the large glass areas typical of Vancouver housing. People want large windows for the light and view in a climate with long periods of cloudy weather in the winter.

In other words, if it looks too far out, and people don't buy into the design, they're going to do what they can to change it over time. ☼

Health and the Environment

Some may still question the connection between health and environment. After all, we've all survived quite well without dropping dead. Is it alarmist talk, blown up of proportion? Maybe us old fogeys can put up with a polluted environment for a while, because we've become sensitized to it. Then again, the sensitivity can build up. But what about the little kids?

I recently came across a very revealing brochure put out by Health Canada. It is titled: ***A Parent's Guide to Your Baby's Health and the Environment****. This is a useful review not just for new parents, but also for all homeowners, builders and renovators.*

Toxics are harmful to children in even small quantities as a child's body may absorb toxic material more quickly than an adult's. Toxic chemicals can easily enter a child's body as children tend to get cuts and scratches and to put their hands in their mouths.

Any given amount of a toxic material has more effect on a child because of the smaller body weight. The still-developing brains and nervous systems can be permanently damaged by some substances, while developing lungs are sensitive to other chemicals. Children's sensitive skin and membranes put them most at risk.

Furnaces, gas stoves, kerosene heaters, automobile engines and tobacco smoke all produce many emissions that include carbon dioxide, water vapour, carbon monoxide, nitrous oxides and other compounds. Unless properly installed and vented, all combustion appliances will spew these compounds into the house. Carbon monoxide is the most common and lethal of the by-products that can be generated by this equipment in a house.

Moulds, fungi, viruses and bacteria flourish in warm, moist conditions. That is why we have to install ventilation systems to vent the kitchen and bathrooms to the outside. This helps manage humidity in the house and avoid condensation on windows and walls.

Household cleaners contain corrosive acids such as hydrochloric acid, oxalic acid and sulphuric acid, or caustic alkalis such as ammonia and sodium hydroxide. Ammonia is present in cleaners; sodium hydroxide (lye) is found in drain and oven cleaners; and hydrochloric, sulphuric and oxalic acids are present in metal cleaners. Volatile organic compounds (VOC's) are used as solvents, carriers or propellants in many household prod-

ucts. Some readily evaporate and can be absorbed through the lungs, the skin and the digestive system.

Phenol and cresol are found in products used for disinfecting, deodorizing and sanitizing. Phenol can temporarily shut down the sensory nerve endings. Cresol targets the liver, kidneys, spleen, pancreas and central nervous system. Pine oil, another common component of disinfectants, is chemically related to turpentine. Prolonged exposure to turpentine vapours causes inflammation of the eyes and nasal passages, bronchitis, pneumonia, rapid heartbeat and breathing, inflammation of the kidneys and dizziness.

Methylene chloride is used widely as an industrial solvent and paint stripper, and at certain levels, can have almost the same effects as alcohol. It is also a suspected carcinogen.

The chemicals used in pressure-treated wood (creosote, inorganic arsenic, pentachlorophenol (PCP) or copper salts), can all have harmful effects on humans. Exposure can cause skin or respiratory irritation, cramps, diarrhea, fever, liver damage, corrosion of skin or mucous membranes, or risk of lung cancer, depending on the preservative. Use of creosote or PCP-treated wood in items that come in contact with the skin, such as benches, lawn furniture, decks or deck furniture should be avoided. Bury, do not burn, remnants of pressure-treated wood; use protective clothing as directed by the manufacturers, and wash work clothes separately from the family wash.

Common domestic pesticides toxic to humans include malathion, diazinon and chlopyrifos. These pesticides are easily absorbed by inhaling, swallowing or through skin contact. Repeated inhalation or skin contact may increase the risk of poisoning. Best not to use these pesticides especially when children are around. If spraying indoors, ensure adequate ventilation, and that adequate time has elapsed to vent residual fumes. If spraying outside, choose a windless day.

Solvents may contain toluene or methyl hydrate (methyl alcohol), which can cause blindness when absorbed, inhaled or swallowed. These are common in shellac, duplicating fluids, paint strippers and craft dyes.

Materials containing epoxy glue, formaldehyde, nickel and dichromates can quickly make a child prone to developing lifelong allergies.

With a little care, many of these substances can be avoided - even for the most demanding tasks.

Makes you wonder how we have survived so long! The lesson is, avoid the worst of the products if you can, and those that can't be avoided, use with extreme caution.

One of the biggest mysteries to me is the behaviour of so many on the job site. One trade may be on the site wearing respirators and other safety equipment required for the material they are using. At the same time, another half dozen persons, doing other jobs, are working as if nothing extraordinary was happening on the site. As the saying goes, there's something wrong with the picture! ☼

How good is the air quality in the average older house?

A survey of 20 medium air tightness houses (2 to 7 air changes per hour at 50 pascals) in Saskatoon offers an interesting snapshot. The average age of each was 25 years. Measurements of pollutant sources in the 20 houses were done for formaldehyde, 26 volatile organic compounds (VOCs), relative humidity, and carbon dioxide.

The measured air change rates varied from a low of 0.08 air changes per hour to a high of 0.43 ac/h, with an average air change rate of 0.20 ac/h. The average air tightness of the 20 houses was 2.61 ac/h at 50 Pa.

[The *air change* rate is a measure of how much air exchange there is in a building under normal operating conditions. The measurement of *air tightness* is the air change under a uniform pressure (typically 50 pascals). This condition is seldom experienced by a house, but is a standard test condition used when determining how air tight a house is.]

All of the houses had natural gas fired forced warm air heating systems.

Formaldehyde readings in 19 out of the 20 houses were below the Health Canada action guideline of 0.1 ppm houses (the average was 0.034 ppm). 19 out of the 20 houses were able to meet the 0.05 ppm Health Canada target for new houses.

The sum of the 26 VOCs sampled in the houses averaged 127 micrograms/m³. No standards exist for VOCs in houses, although a tentative European standard of 300 µg/m³ for total VOCs (TVOC) has been suggested with no one chemical representing more than 30 µg/m³. The TVOCs normally would exceed the sum of the 26 VOCs that were measured in this study. 13 of the 20 houses had individual VOCs that exceeded 30 µg/m³.

Relative humidity measurements in the house averaged 35%, with values varying from a low of 18% to a high of 64%. If only winter measurements are counted, the maximum relative humidity was 47%. Seven of the 15 houses with winter relative humidity measurements were found to be below the relative humidity value of 30% recommended by Health Canada Guidelines.

Carbon dioxide values, based on two spot measurements in each of the 20 houses, averaged 708 ppm, with the highest value 1127 ppm. These measurements were made in the living room during the daytime. The ASHRAE 62-89 standard recommends a maximum value of 1000 ppm; the Health Canada guideline allows a maximum value of 3500 ppm. Normal background levels outdoors are about 350 ppm (but are expected to rise to 500 ppm by 2030 due to global warming).

Ventilation standards are designed to ensure good indoor air quality and also to provide protection against depressurization. The National Building Code requires that any exhaust and device with a capacity of 75 l/s (150 cfm) must have make up air provided if there are open(naturally aspirating) combustion appliances in the house. This is done to limit the depressurization to no more than 5 pascals. 18 of the 20 houses tested were able to meet the backdrafting standard of 5 Pa for intermittent operation of fans. The 2 houses unable to meet the standard had range hood fans with air flows of 110 and 120 L/s (approx. 220 and 240 cfm)..

In 17 of the 20 houses, the chimneys were able to establish flue gas flows when an exhaust fan air flow of 90 L/s was placed on the house. The value of 90 L/s was the threshold value originally proposed for the 1995 National Building Code. (The value was lowered to 75 L/s in the final version of the code). Below 90 L/s of ventilation flow, an exhaust only ventilation system could be used. Above 90 L/s, a supply fan would be required to provide pressure balance.

The average total exhaust flow due to bathroom exhaust fans, range fans, clothes dryers and other exhaust fans in the houses tested was 66.6 L/s, with the clothes dryers having an average flow of 39.4 L/s. The highest measured flow from a single fan was120 L/s from a range fan. ☼

Dust Particles in Indoor Air

Dust affects indoor air quality. All human activity is a source of urban particulate pollution - traffic being an important component. The dark streaks on carpets at perimeter walls, or the black dirt that can be seen on ventilation system fresh air filters are obvious to the naked eye. This background pollution is becoming a growing concern. However, there are other sources of particulate matter also - everything from insect bits and feces, to dead human skin, fabric fibres, pollens, and plain dust. Such contaminants can be detrimental to human health and comfort and are an important factor in indoor air quality.

Particle size has a major effect on health. Particles can vary in size from fractions of a micron (µm) up to clearly visible material of 100 µm or more. Most of the particulates inside a house are derived from the outside air. Indoor sources include insect fragments, especially in the 10 micron range (a human hair is about 10 µm thick).

Until recently, research and standards have been based on 'respirable' particles of size up to 10 µm as this is the threshold at which larger particles start to settle out. New research is beginning to show that smaller particles (particle sizes up to 2.5 µm) are critical. They are thought to cause most damage. These small particles can penetrate the deepest levels of the lung, and are difficult for the body to filter out or expel.

As these particles are extremely small, is it worth worrying about? A Harvard study has shown that for each 10 µg/m3 of particles up to 10 microns, there is a measurable increment in the death rate, although present standards are set at 50 µg/m³.

Studies in Boston have shown that indoor and outdoor concentrations of small particles is similar in the early morning (i.e., at 3:00 a.m.). During the day, particles in the air indoors are influenced by household activities, especially cooking and vacuum cleaning.

A California study looking at dust sources noted that indoor to outdoor ratios depend on the air change rates. As could be expected, more of the smallest particles (up to 2.5 µm) get into the building. At about 2 air changes/hour the 2.5 µm particle concentration approaches about three quarters or more of the outdoor value. ☼

***Particles in Buildings Seminar** at the ASHRAE Summer meeting, Boston, June 1997.*

Formaldehyde Testing

Testing building materials emissions is a challenge. An international effort is underway to develop universally acceptable test methods at the laboratory scale. But lab scale is not the same thing as using larger quantities in a whole building. In a house, there are many of other materials and constantly variable environmental conditions to confuse the situation.

This became evident in a recent study done by the US Environmental Protection Agency (EPA) with the National Particleboard Association. The object was to evaluate methods for measuring the contribution of urea formaldehyde bonded building materials (such as particle boards) to indoor formaldehyde concentrations in newly built conventional houses.

Evaluating the contribution of UF-Bonded building materials to indoor formaldehyde levels in a newly constructed house.

Paper presented at Washington State University 30th Annual Particleboard/ Composite Materials Symposium, Pullman, Washington April 1996

Indoor formaldehyde concentrations were measured in a conventional newly built, single-family house that contained two different combinations of UF-bonded building materials with known emission characteristics. Significant technical and logistical problems inherent in studies of this type were noted.

The intent was to test a house with four product loadings installed. Indoor formaldehyde measurements would be taken over a 30-day period. At the end of the 30-day period, the products would be removed from the house, and the house would be allowed to "air out" for several days until a new equilibrium level was reached. Then the next set of products would be installed. Because of higher costs than anticipated, only two conditions were tested.

Emission Characteristics of Particleboard and Plywood Panelling Used

Product	Emissions (ppm)
Particleboard underlayment	0.144
Plywood wall panelling	0.114
Cabinets	0.053
Interior Doors	0.052

The house used in the test was a modest, conventionally built 1326 sq.ft. two-story Cape Cod style house with a full basement in Centreville, Maryland. Total volume of the finished living space was 10,746 cubic feet.

Urea formaldehyde bonded products used included $^5/_8$" particleboard underlayment, ¾" industrial particleboard for countertops, ¼" hardwood plywood wall panelling (3-ply birch face, tropical hardwood back and core with 7 cut grooves along the length of each panel to simulate random width lumber planking) interior partition doors, and kitchen bathroom cabinets. Emission properties of each product were known.

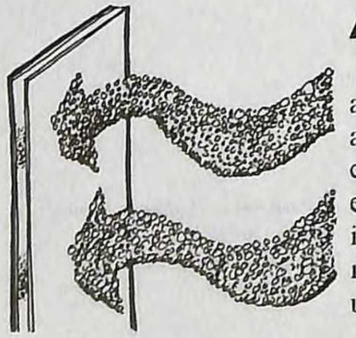
The products were stored in a warehouse until they were installed in the house. During storage, products were wrapped in 6-mil plastic to minimize any formaldehyde off-gassing. They were meant to be kept under controlled conditions. However, it was discovered that temperature control in the warehouse was marginal and that temperatures ranged up to 85 °F.

Although it was intended to control indoor conditions, the contractor had problems controlling relative humidity levels in the house. While targeted at 50%, humidity levels inside reached more than 70% in late June. (High humidity causes higher formaldehyde emissions).

Ventilation rates were controlled by a heat recovery ventilator (HRV) attached to the heating and air-conditioning system.

The highest indoor formaldehyde concentrations were 0.076 parts per million after products were installed. For all three loadings indoor concentrations peaked in the first month. After 30 days, average indoor formaldehyde concentrations in the house were less than 0.045 parts per million. Health Canada's exposure guideline for formaldehyde in residences is 0.05 ppm (the action level is 0.1 ppm).

The carpet and underlay used did not have any effect on the rate of formaldehyde emissions from the particleboard underlayment into the rest of the house but the painted gypsum wallboard acted as a significant sink. ☼



Airborne Pollutant Sinks

Contaminants are a normal element of indoor air. The air inside is always dirtier than outdoors, as many chemicals are released indoors, into a confined space. These are not always removed efficiently to the outside. The contaminant sources include all the materials we bring inside: building materials, fittings, furnishings, consumer products, clothing, animals, etc.

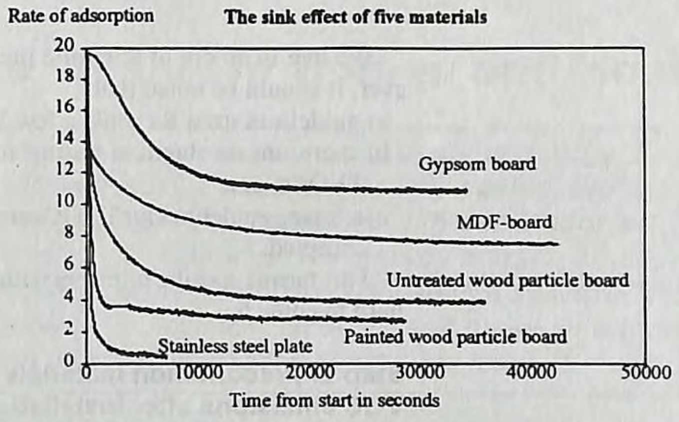
The standard way of considering ventilation for air quality is to consider it as a dilution process. The air quality is assumed to be the difference between what is supplied from the pollutant sources (the emission rate) and what is taken out by the ventilation system.

It has increasingly been recognized that other processes have an important effect on indoor air

quality. All materials in the room interact with the air contaminants and may absorb them (just like your clothes absorb cigarette smoke from a smoky bar). In this way they act as pollutant sinks. When a large concentration of pollutants is brought into a room the release of chemicals leads to high short term pollutant concentrations in the room. This means there will be strong "sorption" on material surfaces. The traditional thinking is to deal with this pollution by turning up the ventilation to high speed.

However, the absorbed compounds migrate back into the room, so that the exposure time is longer than first thought.

A material that accumulates contaminants as a pollutant sink at first has a positive effect on the contaminant level. The problem is that the surfaces give off the absorbed compounds at a rate that increases with the amount absorbed. ☼



The diagram displays the rate of adsorption as a function of time for different material surfaces exposed to a stream of air, contaminated with toluene. The first rapid adsorption on the steel plate, quickly stops as the surface concentration reaches equilibrium with the concentration in the gaseous phase. For the other surfaces, such an equilibrium is not attained, due to the fact that the adsorbed compound more or less rapidly diffuses into the material. The difference between different materials is obvious. Gypsum board, wood particle board and other porous materials can quickly build depots of contaminants. It is interesting to note the restriction of diffusion caused by the acrylic paint on the wood particle board.

*From Focus: **Built Environment** Royal Institute of Technology, Centre for Built Environment, Gavle, Sweden*

An Approach to Reducing Pollutants

Commercial building owners and employers are beginning to realize that if poor indoor quality increases the absenteeism rate by only 2.5% then the increased annual costs because of this higher absenteeism rate can be similar or higher than the cost of utilities or maintenance and operation of a building over a year. Other positive economic impacts for a clean, healthy building include reduced liability exposure, improved building marketability, reduced health care costs, lower operating costs, and increased comfort and productivity.

In residential applications, there have been anecdotes about paybacks achieved by sensitive people for the extra costs of building healthier homes. These come as a result of reduced drug costs because health has improved. A long term study now underway is investigating the benefits of improved indoor conditions in R-2000 homes.

As a result of increasing complaints of sick buildings, the California Department of Health Services has developed guidelines for the reduction of volatile organic compounds (VOCs) from construction materials in newly built or remodelled office buildings. VOC's are a contributing factor in many problem situations.

A five-step approach to reducing exposure to VOCs has been developed. While these were developed for commercial buildings, these also have their application for houses.

Step 1: Evaluate and select low VOC impact building materials and products.

A low VOC impact material is one that when installed in a building results in minimal or reduced exposure of occupants to VOCs. This is the most critical step. Four tasks when evaluating materials are:

1. Identify target materials and products for further investigation, based on the estimated installed quantities (materials used in large volumes are more likely to be a problem than something used in very small quantities).
2. Collect detailed VOC related product information for those materials, based on Material Safety Data sheets (MSDS), product specifications, test results or any other information that may be available.
3. Evaluate building products based on available data.
4. Select building materials based on MSDS and/or emissions testing results. Unfortunately, there is a lack of industry standardisation of the reported information and MSDS are not always complete.

Reducing Occupant Exposure to Volatile Organic Compounds (VOCs) from Office Building Construction Materials: Non-binding Guidelines.
By Leon E. Alevantis
California Department of Health Services

We live in an era of scientific precision. However, it should be noted that:

a) guidelines exist for only a few VOCs;
b) there are no standard testing methods for TVOCs; and
c) existing guidelines for TVOCs are not widely accepted.

This means specific numbers with certainty are hard to come by.

Step 2: Precondition materials to reduce VOC emissions after installation.

Condition materials at the manufacturing or assembly facility, at a "bonded" warehouse with appropriate ventilation, or in a dry, well-ventilated area other than the one where the materials will be installed, until emissions have been reduced. Carpets are a material that can be treated this way. There are no field data demonstrating the minimum length of time needed to effectively precondition various building products.

Step 3: Install building materials and products based on their VOC emission decay rates.

Install building materials based on their emission and adsorption characteristics. Typically, wet products such as paints, adhesives and deck levelling compounds should be installed first. Wet products are usually characterised by very high initial emissions. Most solvents and other chemicals in wet products are emitted for a few hours or days after installation as the material cures. Porous materials, such as carpets and fabric-covered office dividers, or fabric wall coverings should be installed last, as these materials have a high capacity to absorb other materials, thus becoming "third party" pollutant sources.

Step 4: Ventilate a building during and after installation of new materials.

The maximum amount of outside air should be provided during and after installation of VOC emitting materials for the maximum amount of time feasible (this process is known as a building flush-out). There are no data on the recommended duration for building flush-outs. A conservative approach is to flush out as long as is economically feasible, but not less than continuously (24 hours per day) for seven days.

Step 5: Delay occupancy until VOC concentrations have been reduced.

Because VOC concentrations are highest during and immediately after construction, it is important to allow sufficient "flush-out" time before occupants move in. ☼

How much per square foot?

How much does it cost?

Cars		Houses
$/pound		$/sq.ft.
Economy		**Starter home**
$6.98	Honda Civic	$85.00 to 100.00
$7.44	Toyota Camry	
$6.74	Chevrolet Cavalier	
Mid-size		**Mid range**
$7.51	Ford Taurus	$100.00 to 130.00
$9.41	Pontiac Bonneville	
$7.59	Chevrolet Lumina	
$7.20	Chev Astro Van	
Luxury		**Luxury**
$11.05	Cadillac Catera	$180.00 plus
$13.33	Lincoln Continental	
$17.25	Mercedes Benz E320	
$33.94	Porsche 911	

Is there a day we don't get a question asking about the construction cost for new or renovation work? Who hasn't had customers that pick away at a project adding or shaving a few square feet and multiplying the result by the cost they have memorized, ignoring all the other factors that may have a bearing on the total cost?

I am always amazed at how people have locked into the cost per square foot as a yardstick and don't want to recognize that is only an approximation that is only useful for general budgeting purposes. It doesn't help that some builders in the industry also price jobs by the square foot, and property appraisers treat it as gospel.

Funny how we don't price other products by the unit, but we zero in on unit prices for housing!

What would we pay for cars if we bought them by weight? For fun, I looked up prices for a random selection of cars - the table shows the cost. A comparative cost per square foot for new construction in Vancouver is also shown. I am sure that questions will be raised about what model, where, what options, etc. Doesn't the same apply to housing specs? ☼

Air Quality in Homes and Health

Air is something we don't think about until there is a problem. We know that we need clean air and that poor air quality can affect health. It takes obvious smells and particulates in the air (in the form of urban smog or smoke infested air from big fires) to get our attention. Recently the Globe and Mail, Canada's national newspaper, featured a front page story about the condition of indoor air quality and its impact on health.

Most air quality research and standards have been developed for industrial environments, where workers are exposed to very large concentrations of pollutants for short, known amounts of time. However, we now recognize that low concentrations over a long time, as in a home environment, are equally significant.

The medical community has noticed a significant increase in respiratory ailments, especially asthma. Medical researchers are pointing out that indoor air pollution is a greater threat to sensitive lungs than industrial pollution. A major reason seems to be related to lifestyle. Increasingly, we are spending more time indoors, with new toys such as VCR's and computers. At the same time, homes are becoming more draft free with lower natural air change rates.

That indoor air quality can be worse than outdoors has been identified some time ago. But there is a major misconception about energy efficient homes that equates well sealed, draft free energy efficient homes with bad indoor air quality. This ignores one of the fundamental principles of Canadian low energy home construction that recognizes *a house is a system*. This means that all elements work together. You insulate and air seal the house and at the same time, make sure that an effective ventilation system is installed.

From the very start of the R-2000 Program mechanical ventilation was a strictly enforced requirement. Unfortunately, many people, both contractors and home buyers, only heard the "seal and insulate" message. They did not hear the message that the house operates as a system, and did not understand the need for ventilation. As a result, not all were willing to install effective ventilation and many "clones" were built. They were well insulated and air tight but without the necessary ventilation. The fault was not with the R-2000 program or R-2000 technical standards, rather the way in which the industry and the public took up the message.

there is a major misconception about energy efficient homes that equates well sealed, draft free, energy efficient homes with bad indoor air quality. . . . Canadian low energy home construction recognizes a house is a system. This means . . . insulate, air seal, and make sure that an effective ventilation system is installed.

There is ample documentation proving that certified R-2000 houses have superior indoor air quality and meet all the performance claims made. Monitored results of house performance has provided conclusive evidence that properly installed, effective ventilation systems work. Code authorities have been sufficiently convinced, and have incorporated ventilation requirements into the building code.

However, just installing a ventilation system will not provide a total solution to the indoor air quality problem. Reducing the exposure to allergy inducing irritants in the home is also important. Some of these are nothing a builder or designer can do anything about - because it is the pets, furnishing, clothing and other artifacts people bring into the house, and occupant lifestyles. However, there are things a builder and designer can do to make a home healthier. These include avoiding those elements that may contribute, or aid irritants, such as careful selection of finish materials, effective ventilation system, and effective air filtration system.

These are elements that can be incorporated in any home. It doesn't have to be an R-2000 certified home. ☼

R-2000 web site

The R-2000 has an information centre on the Internet. It can be accessed on the Natural Resources Canada web site, which is located at: *http://eeb-dee.nrcan.gc.ca*

The R-2000 information is at: *http://eeb-dee.nrcan.gc.ca/new_houses_r2000_e.htm*

The R-2000 information is general, but it provides an overview of the program. The NRCan site is useful to access other energy use information, including energy efficiency standards for equipment and appliances.

R-2000

For information on the R-2000 Program, contact your local program office, or call 1-800-387-2000

Technical Research Committee News

Canadian Home Builders' Association

Unvented Gas Fireplaces

Unvented gas fireplaces are a relatively new product in North America. These have a gas burner and ceramic log but no chimney. All exhaust products, heat and moisture are exhausted into the room where the appliance is located. Oxygen depletion sensors theoretically protect the occupants by giving them a warning if oxygen levels drop significantly.

The contribution of unvented gas fireplace combustion to indoor levels of CO, CO_2, NO_x, water vapour, and other pollutants will be significant. These units can match or exceed the size of a hot water heater or a small furnace used for the whole house.

The fireplaces are sold with the warning that they should not be used continuously as a heating device, that ventilation be provided, and that they be maintained annually by a professional.

Simulation results show that unvented gas appliances exceed Canadian guidelines for indoor air quality. *The study used by the fireplace industry shows acceptable levels of combustion products in part because the maximum allowable pollutant concentrations used are much higher than Canadian guidelines. The study also uses theoretical house air change rates that are higher than the* ***actual*** *rates measured in many Canadian houses.*

Proponents of unvented fireplaces argue that every house should have an effective ventilation system installed and operating, which would maintain a minimum air change rate of 0.35 air changes per hour. However, such systems are rarely found in Canadian houses. Many houses have natural air change rates lower than this threshold.

The gas fireplace industry recommends units be sized based on room heating requirements. However, the recommended fireplace size for many northern US installations is often smaller than the smallest device available. Retailers admit that the small units recommended are often ignored by salespeople and consumers. Promotional literature typically fails to emphasize or mention the size limitations that the American Gas Association (AGA) finds necessary for safe use.

Many models of acceptable vented fireplaces are now available in Canada, and they are being installed in great numbers. The cost and convenience of unvented fireplaces make them appealing for existing houses. However, hundreds of thousands of unvented gas fireplaces are sold every year in the US. Manufacturers and distributors are now requesting approval from Canadian regulatory authorities. It must be stressed that unvented gas fireplaces will probably exceed Canadian nitrogen dioxide guidelines and contribute a significant amount of moisture to the house even if they are:

- properly sized
- properly installed and diligently maintained
- used for no longer than four hours at a time,
- installed in a house with an effective, distributed ventilation system.

Based on surveys of heat recovery ventilators, installations with such attention to detail will be rare. The degradation of the indoor environment could in reality be even more pronounced that the modelled results. Builders and regulatory officials will probably be solicited in the near future to support the introduction of unvented gas fireplaces in different provinces.

CMHC's view is that unvented gas fireplaces are not suitable for Canadian housing.

It is clear from CMHC and other Canadian research that unvented appliances are incompatible with Canadian houses. The spillage of combustion products from fuel-fired furnaces, hot water heaters, and fireplaces leads to unacceptable indoor levels of contaminants. That is why codes, standards, equipment and installation practices have been changed in the last ten years to protect householders from combustion gas spillage. These will have to be reconsidered if large appliances with 100% spillage were to be approved.

Liability in House Construction

Professionalism carries responsibilities and liabilities along with it. Recent trends by municipal governments to off-load code enforcement to third parties may have altered builder liability. CMHC and IRC are working with CHBA on a preliminary investigation of changing liabilities in the housing industry. This will lead to a more in-depth study later.

The kinds of issues that have to be considered include: liability to third parties for economic losses; liability of municipal building officials; new approaches to code enforcement; liability of owner-builders; liability chill on new technologies; implications of new objective-based codes; liability for product defects; dealing with contaminated sites; liability as an enforcement mechanism; unanticipated liabilities affecting homeowners; fines and penalties; complaint settlement.

This is intended as an issue paper to identify major subject areas are where further research is needed. If any readers have any thoughts about builder's liabilities, contact the TRC.

Codes and Standards

The Objective-Based code process continues to proceed. It has been slower than anticipated, but IRC staff believes a newly formatted National Building Code in the year 2001 is still achievable.

CHBA is represented on the NBC committee looking at better coordinating the national and provincial review processes.

The CHBA president has reiterated CHBA's commitment to energy efficiency through voluntary measures, not mandatory adoption of energy codes.

R-2000 Program

CHBA has sought and received written confirmation of Natural Resources Canada's commitment to the R-2000 Program. The association and NRCan are presently collaborating on a review for the long term administration and delivery of this important building program.

The Technical Research Committee (TRC) is the industry's forum for the exchange of information on research and development in the housing sector.
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IRC involved in new generation of standards development

By Will Koroluk

Writing codes and standards for building products has never been quick and easy. A lot of committee work supported by scientific research and technical advice has been the norm. The process has sometimes been lengthy and always expensive.

Now, there's a new player on the field and a new game plan. A construction industry group named TISSQ, the Thermal Insulation Systems Standards and Quality Consortium, was formed to assist the Underwriters Laboratories of Canada (ULC) in writing standards for thermal insulation. Among TISSQ's objectives, says Dr. Mark Bomberg, of the Institute for Research in Construction (IRC), is to derive a procedure for labelling cellular plastic insulating material based on the material's thermal resistance performance over a 15-year period.

The task group, with IRC as one of the founding members, is made up of a broad cross-section of interested industry and non-industry groups, including IRC's own Canadian Construction Materials Centre (CCMC). Everyone involved hopes the work will proceed quickly, and, thanks to extensive use of volunteers, cheaply.

Some of the standards formerly produced by the Canadian General Standards Board (CGSB) have been moved to ULC, including those involving thermal insulation. These are among the standards in which TISSQ has an interest. Dr. Bomberg says ULC was chosen to spearhead the work based upon bids received from standards-writing organizations, "but whether the work was handled by the ULC or CGSB was not the issue. The issue was one of finding a new mechanism by which we can produce better results for much less money in a very tough competitive time."

The procedure also provides an example of how closely IRC is involved in the development of standards even though it does not write standards itself. The close liaison that ULC, TISSQ and IRC maintain with the American Society for Testing Materials (ASTM) also gives Canada a strong input on the North American scene, Dr. Bomberg says.

But that is not new. IRC's reputation in the field of thermal insulation and the development of standards goes well beyond Canada, says Bill Brown, a scientist who has been with IRC for 26 years. In fact, both Mr. Brown and the IRC's reputation go back to the days when it was the National Research Council's Division for Building Research, which was formed 50 years ago.

When NRC set up DBR in 1947, the new group was to address the general need for building research. It was also assigned three special tasks: to provide technical support for the revision of the National Building Code, to provide technical support to the new national housing agency then known as Central Mortgage and Housing Corporation, and to provide technical support and advice for what was then called the Canadian Government Standards Board and housed at DBR.

Since building codes reference many standards, technical support for the code-writing process meant, by extension, support for the standards-writing process as well. There was a sort of chicken-

Will Koroluk is an Ottawa freelance writer who specializes in building science.

and-egg question involved, Mr. Brown said. Which came first: Support for the standards writers or the research necessary to understand how such things as insulation or air and vapour barriers work so that standards could be written? "They really reinforced each other," Mr. Brown says. "The knowledge that existed here contributed to the development of standards and the development of standards contributed to a better understanding of what knowledge was required."

In this work, Mr. Brown mentions Mark Bomberg and Cliff Shirtliffe as two prominent scientists. Mr. Shirtliffe retired from IRC after more than 36 years, but is still active in consulting and standards development. He recalls that standards in the 1940s and 50s were "quite minimal and lacking in substance." So DBR, Public Works, and CGSB "worked together and developed an improved philosophy for standards."

Another key group was the scientists at the Public Works Testing Laboratory, now closed. DBR would devise a testing procedure and the basis for a pass-fail criterion and then the Public Works Testing Laboratory would test all products and present the (anonymous) results to the standards-writing committee for final selection of pass-fail levels.

A material and product qualification board at Public Works listed products that could or could not be used on government contracts. CMHC did the same for products used in house construction. The lists were widely used in the construction industry. The Public Works tests were done early enough to give manufacturers a chance to improve their product if they could and resubmit it.

As a result, that testing work had a tremendous effect on improving the products on the market, especially regarding vapour and water leakage of buildings, thermal insulation, the sagging of thermal insulation, air leakage of various components and so on. A tremendous effort.

When the energy crisis was triggered by the Arab oil embargo of the early 1970s, the Canadian Home Insulation Program (CHIP) was born. "CHIP and CMHC looked at the existing standards and decided that for the various vapour barriers and insulations they were inadequate, so they asked CGSB to rewrite all the insulation standards", said Mr. Shirtliffe.

"IRC was front and centre in that crash program, supplying all the technical information and testing." The result was they were all rewritten in the five years between 1973 and 1978 "and it wasn't just standards for the materials themselves, but how to install them."

Throughout, DBR/IRC provided technical advice and assistance, as well as having its people do important committee work with such organizations as ASTM. Indeed, the Bomberg-Shirtliffe duo worked with ASTM for more than 20 years. Dr. Bomberg says they were once asked for a list of the various task groups, committees and subcommittees they were involved with and the list took up six pages.

Eventually, as the world got smaller, the International Standards Organization came into the picture, and IRC was in the front line again, with Mr. Shirtliffe chairing the ISO subcommittee on building insulation. The result, he recalls, was that "we got a lot of the Canadian thinking into the standards across the world." There was even some quasi-diplomatic work involved. Mr. Shirtliffe remembers that when the European common market got into the act, its work on thermal insulation and moisture came to a standstill because of differing philosophies. Canadians, he said, "were able to go in, look at the problems and come up with solutions that moved things along."

As new materials are invented, as building codes develop, "IRC researchers remain very much active in the standards business," says Mr. Brown, often through close cooperation with CCMC. Although CCMC now functions as part of IRC, it could be considered as the materials evaluation service that had been operated by CMHC, now revamped and with a national scope. The move brought it into closer contact with IRC's scientists, who frequently provide technical support for the evaluation guides CCMC produces for the evaluation of innovative products or systems. As an example, he says, "our understanding of building science and some of the tools and techniques we've developed helped CCMC not long ago to develop an evaluation guide for air barrier systems for low-rise buildings." ☼

Letters to the Editor

Re: "Long Term Abundance" (Solplan Review September 1997)

You seemingly express concern about the reserve/production ratio of, in this case, natural gas reserves in British Columbia.

You might be surprised to learn that B.C. has the highest reserve/production ratio for gas in all the Provinces. What is becoming the norm in North America is something in the order of ten years. The same is generally true for crude oil in the US, Norway, etc. A reserve/production ratio of ±10 years in no way implies that resources are depleted in ±10 years. Establishing and carrying reserves entails evaluations and decisions based upon economic and technological considerations. Only in truly unique geological areas, like the Middle East, would there be unique exceptions.

Stephen R Goudie
Manager, Economic Analysis
Newfoundland and Labrador Hydro

I appreciate the clarification. It nevertheless is an undeniable fact that fossil fuels are not renewable - once the resource is used, there is no more. Major producing areas in the world have already passed their peak production. In other words, they are starting to run out of resources.

The USA is now importing more oil than it produces (how sustainable is that in the long term?). The North Sea oil fields have passed their peak production and they have been in operation for only 30 years or so. Sure new fields being discovered and developed, but that is still a (relatively) short term source. On top of it all, the use of fossil fuels is altering the global environment. There is little doubt about that, even if the oil industry is in a state of denial, and campaigns against it.

Unfortunately, the economic considerations on which so many policy decisions are made do not include issues such as environmental and social impacts that in the end are much more important. Ed.

That we will run out of some energy sources at some point in time is a given. But have we not cried wolf for so long that our cries are being used against us? "What energy shortage?" seems to be the public attitude.

Oh yes. I believed the trumped up OPEC crises. In 1977 I built what may have been the first double wall superinsulated house in the USA. I continue to build houses with annual heating bills of $30.00 for electric heating - the customer's choice, not mine.

Gene Leger
New Boston, NH

I agree - at times it seems discouraging, but we must keep not give up. This is one case where we are on the right track. Low energy buildings are only one solution to the problem. Ed.

Re: Energy Efficiency Retrofits

At the risk of dwelling on the subject, I must comment on Martin Mattes' reply to Stephen Carpenter in the September 1997 issue. He correctly states that it doesn't make sense to buy "R3 versus R2.2 for a few thousand dollars more . . . " But the cost should be nowhere close to that range. The cost of adding argon gas and low-e glazing is about $1.50 to $2.00 US. So even if your house has large glass areas, the cost difference between R2 and R3 is several hundred dollars, not thousands. At these prices, it's usually a good investment. Exaggerating costs can make any energy improvement look bad.

The concern over reduced solar gain is also misplaced. Some high transmissivity low-e coatings reduce heat loss more than they reduce solar gain.

Regarding condensation—those of us near the coastal climates north of California can't depend on ventilation to keep indoor air dry enough to prevent condensation on cold windows, especially when four or more people occupy a house. Canadian maritime climates are in a similar boat.

Ted Haskell
Oregon State University Extension Service
Energy Program

Re: Wood I-Joist Standard (Solplan Review September 1997)

I would like to point out that there are at least five I-joist manufacturers in Canada, and each has a CCMC product evaluation report.

Bruno Di Lenardo
Canadian Construction Materials Centre
(CCMC) Ottawa, ON

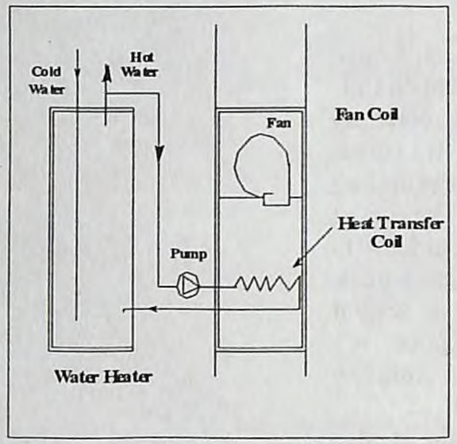
We didn't mean to leave the impression that there are no Canadian wood-I joist manufacturers. The story simply mentioned that the APA wood I-joist standard is not being promoted in Canada at this time because as yet no Canadian manufacturers have signed on with the APA program. Ed.

Energy Answers

Rob Dumont

Several Canadian Advanced Houses (B.C., Saskatchewan, Manitoba, Ottawa) used a single gas water heater to provide both space and water heating. Is this system the wave of the future?

I will answer that question with a qualified "yes."



A sketch of a common system using a water heater and a fan coil is shown in the diagram. Another variation is to use the water heater along with radiant floor heating. Such systems are now called "Combo Systems" or "Integrated Mechanical Systems."

Traditionally, people have used separate water heaters and space heaters. However, as the global warming people have warned us, many traditions need to change. Properly set up, the Combo systems can save much energy.

Advantages of Combo Systems

I see three big advantages with integrated space and water heating systems. First, a single combustion source can be made very efficient for both space and water heating. Second, a combined system eliminates a second gas valve, spark ignition, vent pipe and the accompanying floor space. Fewer components should lead to lower costs. Third, the safety of the heat delivery system can be improved through use of a single combustion air supply and venting system.

Disadvantages

There are, however, some serious challenges to making the systems more popular. Most of the companies that make gas furnaces (Lennox, York, Carrier, Bryant, etc.) do not make water heaters. Likewise, most water heater companies (GSW, John Wood, etc.) do not make furnaces. The one big company that now makes a combo unit is Lennox, which has the CompleteHeat system, a high end product. There are no other big players yet.

Besides the production problems with combo systems, technical challenges need addressing.

Lessons Learned on an Older Combo System

I personally installed a combo system in 1986 in a house here in Saskatoon. The system, which uses a fan coil to distribute the warm air, is fired by a 36,000 Btu/hr input (10.5 kW) induced draft non-condensing water heater. As the house is super-insulated, the water heater can both heat the 2200 square foot house and provide the domestic hot water even though Saskatoon's design temperature is -35 °C. The good news is that the system is still functioning in 1997.

The bad news is that the system has had its share of troubles. Here are some lessons learned from this installation.

Lesson number 1.

Use a water heater that can stand up to the much higher usage that a combo system will experience.

I am now on my **fourth** induced draft fan on the water heater. The first three fans all had bearing failures, likely caused by overheating of the front bearing on the electric motor of the induced draft fan. A typical water heater might run about 800 hours a year, but this water heater runs about three times longer. With the extra heat from the exhaust gases, the fan motors have not stood up.

Lesson number 2.

The check valve must be checked periodically for a malfunction.

Alternatively, if the fan coil is beneath the water heater, and the loop is well insulated, thermosyphoning will be minimized. The check valve is there to prevent thermosyphoning of the heat from the water heater during the off-cycle. With the check valve stuck open, a considerable amount of heat was being dumped into the house even in the summer time. One sign that the check valve is not working is the very frequent cycling of the water heater. Minerals in the water tend to clog the check valve.

Lesson number 3.

Treat the combo unit as a system. Make sure that the water heater is properly sized for the house, and that the fan coil or radiant heating system is properly sized for the water heater.

The fan coil size was not all that well-matched to the water heater. Make sure that the system is properly sized. If the water heater is too large for the house load or, if the fan coil is undersized compared with the water heater the water heater will cycle too often. Frequent cycling is bad for the water heater, increasing the wear and tear on valves and relays, and contributing to lowered efficiency. (Many induced and sealed combustion water heaters have purge cycles that vent warm air to the outside.)

Lesson number 4.

Watch out for high electrical power consumption of the pumps and fans.

Because the combo systems often have a lower heat input than conventional furnaces, the systems must run for more hours during the heating season. The warm air combo systems generally use cooler air temperatures, and require higher air flows than do conventional furnaces delivering the same amount of heat.

A conventional ¼ horsepower fan will use about 400 watts of electricity. Typical furnaces run about 1500 hours a heating season. A combo unit might run twice as many hours. At 10 cents per kilowatt hour, the extra electricity cost to run the fan coil fan another 1500 hours a year would amount to $60 per year. One way to reduce this electricity consumption is to use low pressure drop fan coils, high efficiency motors, high efficiency fans, and high efficiency pumps.

In an earlier column, I had mentioned "*componentitis*" as a major technical problem with Canadian house building. A combo heating system must be designed as a system, and not just as a grab-bag of components. If some good system packages can be put together, I am confident that they will gain a lot of market share. ☼

Rob Dumont is a building scientist with more than 20 years in building energy use and indoor environment. He lives in Saskatoon.

The Heating, Refrigerating and Air-Conditioning Institute of Canada (HRAI) has produced ***"Unified Canadian Guideline for Integrated (Combination) Heating Systems."*** *The manual is a must-buy for anyone working with Combo systems. Copies are available from HRAI for $25 plus 7% GST or 15%HST, plus $4.50 for postage.*

Tel. 1-800-267-2231.

The true cost of candle power

The 1997 IKEA catalogue has a tongue-in-cheek advertisement for candles, offering a package of 25 for $6.95. The copy reads "Just think of all the money you'll save on the next electric bill," reinforcing an old myth about candlelight being cheap. John Davies, a B.C. Hydro customer Service Engineer, did a calculation that sheds some light on the issue.

Surveys show an average light bulb may be on for 3,000 hours. The typical 60 watt light bulb lasts 1,000 hours so you would use three of them over a year. At a cost of $0.0577 per kWhr, it costs $10.39 for the electricity to run that 60-watt bulb plus about $3.00 for the original bulb and two replacements for a grand total of $13.39.

At $6.95 for 25 candles that last an average of 6 hours, the cost per hour is $0.0463. However, it would take 500 candles to provide 3000 hours of light for a total cost of $139.00.

If we want to be fair about it, we should compare equivalent quantities of light. A 60-watt lamp emits 1060 lumens, but a candle only gives out 12.5 lumens, so it would take about 84 candles burning at once to produce the same amount of light as one 60-watt bulb!

Thus, the true cost of an equivalent amount of candlelight for an equal amount of time would cost you $11,676 per year. And that's just to replace one light bulb in the house!

And of course we're not considering the impact on indoor air quality, heat build up, etc.

Circuit Breaker Product Recall

There is a potential problem with the Federal Pioneer brand NC015 and NC015CP circuit breakers manufactured between August 1, 1996 and June 11, 1997.

the breakers will sometimes continue to protect anticipated overloads and short circuit currents. If the circuit breaker does not perform as intended, there is a potential for property damage and/or personal injury. There have been no reports of injuries or fires because of the potential problem, but the manufacturer (Schneider Canada) wants to find and replace these circuit breakers.

A toll-free call centre at 1-888-519-5556 or 416-234-6407 (Metro Toronto) is available for more information about the program.

You may want to check with your electrical contractor to find out if any of your homes and homeowners are affected. More detailed information is available by calling your local Schneider Canada office or you can visit their web site at *www.schneider.ca*

Coming Events

Jan. 14-15, 1998
Ontario Builder Forum '98
Toronto, ON
Information:
Tel: 416-447-0077
Fax 416-443-9982

February 8-11, 1998
CHBA National Conference
Hamilton, ON
Information:
Tel: 416-443-9023
Fax 416-391-2118

May 4-6, 1998
Renewable Energy Technologies in Cold Climates
International conference, incorporating 24th annual conference of the Solar Energy Society of Canada
Montreal, Que
Information:
Tel: 613-234-7004
Fax. 613-234-2988

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